National Aeronautics and Space Administration
Ames Research Center
Moffett Field, California

# NASA ASTROBIOLOGY INSTITUTE (NAI)

# IMPLEMENTATION PLAN

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## 1. PLAN PURPOSE

This document describes the implementation plan and overall approach for the management and operations of the NASA Astrobiology Institute (NAI) located at NASA Ames Research Center. NASA Ames Research Center (ARC) was assigned these responsibilities by the Associate Administrator for Space Science in a letter dated July 16, 1997. The implementation plan also addresses functional responsibilities of the Institute, the overall implementation approach, the schedule, and the specific responsibilities of the Interim Manager. The permanent NAI Director will revisit the plan subsequent to his/her selection.

## 2. PLAN SCOPE

This plan provides a summary overview of the NAI and its implementation approach. It describes the management organization and reporting plans for the Institute within NASA ARC, as well as with the NASA Headquarters Enterprises. In addition, the plan addresses the responsibilities of the key members of the management reporting chain, from the OSS Associate Administrator to the Institute Director. Finally, it describes plans for network and virtual collaboration, planned resources, top-level schedule, controls and metrics, education and public affairs, and external review. This plan also describes the implementation approach to establish an interim organization for the NAI. The overall implementation approach conforms to the Cooperative Agreement Notice (CAN 97-OSS-01). The quality management system at NASA/ARC follows system level procedures that meet the standards of ISO 9001.

## 3. NASA ASTROBIOLOGY INSTITUTE SUMMARY

### 3.1 Institute Objectives

The primary purpose of the NAI is to enable world-class multidisciplinary research in Astrobiology. Astrobiology is defined as the study of life in the universe, providing a scientific foundation for the multidisciplinary study of the origin and distribution of life, including the role of physical forces, planetary atmospheres, and ecosystem interactions in the evolution of living systems. These broad areas of study can be described in three basic questions derived from the Astrobiology Roadmapping Workshop: "Where did we come from? Are we alone in the Universe? What is our destiny on Earth and in Space." The NAI will also help to coordinate and to catalyze Astrobiology research across a range of science disciplines and organizations, provide scientific and technical input on the Astrobiology aspects of current and future NASA missions, develop and demonstrate modern communications technologies in support of multidisciplinary research carried out between geographically remote sites, participate in training students at the college and graduate levels, lead in developing a K-12 education program focused on Astrobiology, and provide information to the general public. A defining characteristic of the research done by the NAI will be the formation of integrated multidisciplinary teams of researchers to attack major questions in Astrobiology across a broad scientific front.

Excellence in multidisciplinary research will be the first priority of the Institute. However, NASA will also expect the Institute, once established, to play a leading role in helping to identify and develop new program directions and mission and technology requirements. The NAI will

also play a significant role in the development of a new generation of Astrobiologists. A major goal of NASA's program in Astrobiology is to capitalize on the great public appeal of Astrobiology by building an education and public affairs program to share the excitement of discovery. Institute members will develop their own education and public affairs programs and will work with the Institute Director's office to integrate these separate programs.

### 3.2 Institute Overview

The scientific endeavor of Astrobiology is rooted in the interests of three NASA Strategic Enterprises: Space Science, Earth Science, and Human Exploration and Development of Space. At present, the lead organization and principal funding entity for the NAI at NASA Headquarters is the Office of Space Science (OSS), where the responsibility and authority has been delegated to the Origins Theme Director. The NAI is a partnership between NASA and academic and research organizations to conduct multidisciplinary research in Astrobiology and to train young scientists in this new field. The over-arching theme of the organization is "life in the universe." The Institute, the first of its kind, will provide focus for multidisciplinary research, bringing together astronomers, chemists, geologists, exobiologists and others.

### 3.3 Institute Structure

NAI member institutions were selected by NASA Headquarters based on a competitive, peer-reviewed selection process that was open to the research community in general. The NAI is managed by the NASA Ames Research Center as outlined in this document. The vehicle of solicitation was a cooperative agreement notice (CAN) issued October 31, 1997. An additional CAN may be issued in the near future. It is also anticipated that Associated Institute status may be granted to international organizations by NASA Headquarters.

A cadre of experienced researchers at all the member institutions and an active core of junior faculty, postdoctoral fellows, and students will work and train together and develop innovative ways to cooperate and collaborate, including extensive use of the communication networks of the 21st century. Ames Research Center anticipates hosting many, but certainly not all, of the group activities and will share duties with Institute members who would like to host some subset of these activities.

Because the elements or member institutions are geographically dispersed, the NAI is a non-traditional institute. The member institutions themselves will propose and carry out their own multidisciplinary research but will gain access to additional expertise in diverse fields through NAI. This structure is necessary to ensure that the NAI has the breadth and talent to address the range of fundamental questions inherent in Astrobiology. Accordingly, the universities, NASA centers, and other research entities that make up the Institute will be tied together eventually by a high performance electronic network or networks; by modern management techniques adapted for multidisciplinary research; by frequent personnel exchanges; by an ongoing series of workshops, seminars, and courses; and by sharing common research interests. The Institute will be designed to operate as a virtual institute, bringing modern communications tools such as the Next Generation Internet to link the multi-member, geographically dispersed science teams and laboratories. To this end, NAI will exploit rapidly developing high performance network capabilities, and emerging virtual organization management tools.

The concept for this Institute is relatively new and is, by necessity, experimental. NASA's goal for the Institute--and one of the Institute's principal challenges--will be to use the tools and activities mentioned above, together with others as appropriate, to establish a close and scientifically productive interaction among its members, analogous to what exists in a classical, co-located institute. Achieving this goal will take time, and it is to be expected that the scope and nature of the Institute will evolve over the first few years. It is intended that the research enabled by the Institute will complement the research carried out by individual Principal Investigators in NASA grants programs relevant to Astrobiology.

Each member of the Institute is expected to actively pursue its peer-reviewed and selected research program; to participate actively in Institute activities such as workshops, seminars, classes, training, and education and public affairs; and to work to continuously improve the effectiveness of the intermember connections and collaborations. Much of the interaction is expected to take place through high performance communications linkages. However, members will participate in a variety of NAI workshops or conferences annually.

### 3.4 Institute Director's Office

The scope and nature of the Institute will evolve over time and in cooperation with the members. However, in order to fulfill its primary role of enabling multidisciplinary research between members, as a minimum, the Institute Director's Office activities will include the following:

1. Providing scientific vision and leadership for the Members.
2. Encouraging frequent scientific interchange among Institute members.
3. Exploring and exploiting the technology of high performance networking and applications software as a tool for conducting research and fostering scientific exchange.
4. Preparing and organizing solicitations for the next Cooperative Agreement Notice, organizing and overseeing the peer review process, and recommending selections to the NASA Headquarters selecting official. This will be done in concert with the relevant headquarters Offices and subject to their concurrence and to approval by the Origins Theme Director.
5. Responsibility for organizing the oversight of the NAI fellows program.
6. Helping to coordinate undergraduate and graduate cross-training programs that will allow students in one discipline area of Astrobiology to study and work in another allied discipline, thus training a new generation of multidisciplinary scientists. Part of this effort may include summer schools for undergraduate and graduate students.
7. Working with the members to organize and coordinate seminars and workshops, including those that will utilize high performance networks to link the member NAI institutions; and offer courses in Astrobiology through those networks, drawing on the broad range of expertise across the membership to set up and teach the classes and establish a new course of study. Working with the broader community to organize workshops to determine the need and establish priorities for national facilities for Astrobiology research, to identify the current state of knowledge in the disciplines relevant to Astrobiology and to initiate discussions of interesting, new research directions stimulated by workshop reports.

8. Coordinating the members' programs in K-12 education and public affairs.
9. Disbursing funds (including a Director's discretionary Fund for high-risk/high-payoff research projects and for fostering collaboration between members).
10. Establishing an information repository and distribution center for Astrobiology including, for example, scientific products of members, materials for education and public affairs, and results of community assessment of directions and priorities in the field.
11. Examining and developing emerging management tools and techniques for multidisciplinary virtual research organizations.

### 3.5 Responsibilities of Ames Research Center

The Institute's Director and staff will reside at Ames and maintain the network of member institutions. The Institute will work with the NASA Strategic Enterprises and the broad scientific community to help define new research directions as the field evolves.

For its part, the Ames Research Center will provide the following:

1. Facilitation of access to civil servants engaged in activities related to the content of the cooperative agreement.
2. Access, coordination, and advancement of high performance networking capabilities to enable the Institute members to operate as a "virtual" Institute.
3. Access to ground-based research laboratories and instrumentation at Ames on an as-available basis. Ames will maintain the function and calibration of any associated instrumentation.
4. Notification of and invitation to NASA meetings, symposia, specialized/selected training, and other activities that would provide benefit to the execution of the cooperative agreement.
5. Access to specialized data/information (with any required procedure for maintaining NASA policy and subject confidentiality, when appropriate) that may not be publicly available, when such data/information are deemed essential by NASA/NAI for the NAI to fulfill its mission and objectives.
6. Coordination and facilitation of access to project scientists, managers, and engineers when appropriate.
7. Coordination/facilitation for identification and utilization of any non-Ames NASA research assets on an as-available basis.
8. Provision of the Institute Director's office and staff located at Ames Research Center.

## 4. VIRTUAL COLLABORATION, NETWORKING AND GROUP VIDEO CONFERENCING

### 4.1 Virtual Collaboration

Virtual collaboration is one the key elements and distinguishing features of the NAI. Early in the initial definition of the NAI, a Virtual Collaboration Manager will be appointed to assist the Interim Manager and then the permanent Director in combining various technologies into a functioning virtual collaboration.

NAI's Virtual Collaboration Technology plan will employ a phased approach based on the results of member institution user studies. Virtual collaboration applications to be incrementally employed will include both asynchronous and synchronous collaborative tools and remote science tools.

Asynchronous tools include *PostDoc* and concept mapping. *PostDoc* is a multi-user, web-based application used primarily for the storage and retrieval of a set of information. Concept mapping is a two-dimensional representation of a set of concepts and their relationships. Synchronous collaboration tools such as *Net Meeting* and *Communicator* will provide the capability for real time desk-to-desk collaboration. Remote science tools, as an example, might include applications to enable scientists to communicate with robots.

### 4.2 Networking

Achieving the full-up capabilities of a next generation national electronic communications network will take several years. The NAI is also expected to be a driver in establishing technical requirements and in providing substantial challenges to the network developers. As described below, ARC will provide support to the NAI and each of its lead institutions for end-to-end engineering of the network connections, as well as help with interface and compatibility issues between the network and the member's specific hardware and software configuration.

### 4.3 Group Videoconferencing

Group videoconferencing will be implemented to interconnect member institutions using commercial, off-the-shelf ISDN video conferencing systems

### 4.4 Network Tools

Since the current Internet will be inadequate for the high speed/high quality communications necessary to enable the concept of an institute-without-walls, the NAI will be compelled to exploit rapidly developing high performance network capabilities.

#### 4.4.1 NGI and NREN

A consortium of Federal agencies that includes NASA has been formed to partner with industry and academia to expedite the development of a national high performance networking capability for research and education, under the rubric of "Next Generation Internet" (NGI). This program began officially on October 1, 1997, and is expected to run for at least three years. One of the program's primary objectives will be to engineer and negotiate efficient interconnections between existing and planned high-speed networks. Ames Research Center has been designated NASA's Center of Excellence for Information Technology and, accordingly, has the lead in NASA for the NREN and NGI programs.

The vision of NASA's Research and Education Network (NREN) is to create a next-generation network testbed that revolutionizes end-to-end applications for NASA missions and the Nation. The NASA Astrobiology Institute has been selected by NREN as a key testbed for demonstrating virtual collaboration through high-speed networking. This effort will commence in FY99. It should be noted that NREN only intends to demonstrate technology. Long term operations will require another funding source.

### 4.4.2 Collaboratory Goals

The near-term objectives of virtual collaboration and networking will include applying proven collaboration tools and processes. The collaboratory concept will provide a center without walls, in which the researchers can perform their research without regard to geographical location—interacting with colleagues, accessing instrumentation, sharing data and computational resources, and accessing information in digital libraries.

## 5. MANAGEMENT ORGANIZATION AND REPORTING

An organization has been formulated for the NAI to provide sound managerial and technical foundations. The internal organization, especially the appointment of a Deputy Director or Managing Director, will be revisited by the permanent Director subsequent to his/her selection.

### 5.1 Organization

Figure 1 shows the organizational and reporting relationships for the NAI. The Director of the Astrobiology Institute formally reports to and is supervised by the ARC Center Director. Budget, policy, and scientific direction will be provided by NASA Headquarters, where the principal point-of-contact for the NAI shall be the Origins Theme Director in the Office of Space Science (OSS). An independent Science Oversight Committee, consisting of specialists in the Astrobiology science disciplines and including appropriate representation from the Office of Earth Sciences (OES) and the Office of Life and Microgravity Sciences and Applications (OLMSA), will be established by Headquarters to advise NASA on the effectiveness of the NAI. The chair of this committee will be appointed jointly by Headquarters OSS and the ARC Center Director. The Science Oversight Committee will report findings to the Associate Administrator for the Office of Space Sciences at NASA Headquarters, the ARC Center Director, and the Institute Director. The Associate Administrator for OSS will communicate the findings to the Associate Administrators for OES and OLMSA.

The Associate Administrators for OES and OLMSA will work with the Associate Administrator for OSS to ensure that the scientific program for the NAI includes the elements of Earth Science and Life and Microgravity Science, which have a direct bearing on Astrobiological research. The Institute Director will form an Executive Council made up of the Principal Investigators from the member institutions, which will be the principal technical guiding body of the Institute, functioning like a Board of Directors and providing advice to the Director. These leaders will communicate regularly via conference calls, videoconferences or face-to-face meetings. The Institute Director and the Executive Council will determine the frequency of these communications.

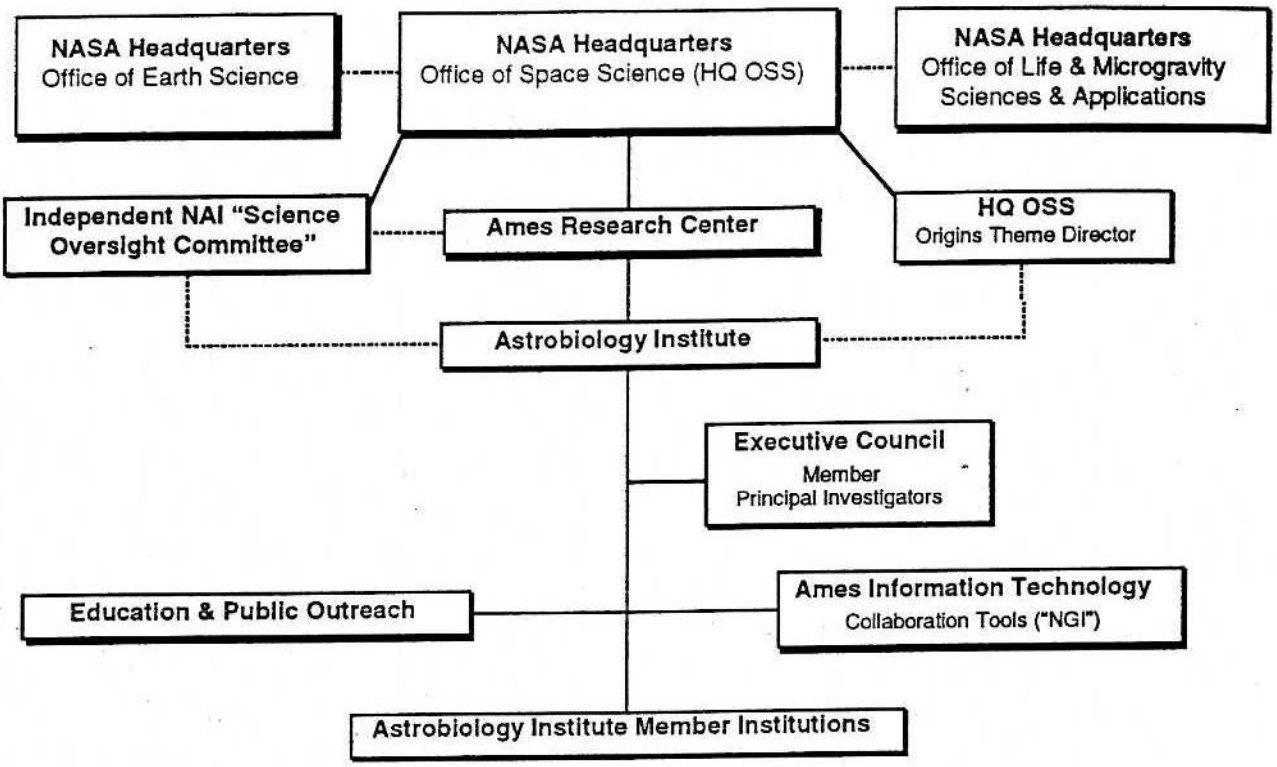



Fig. 1. Permanent Organization

### 5.1.1 Status Reporting by NAI and Members

The ARC Center Director is responsible to the Associate Administrator for Space Science at NASA Headquarters for NAI performance.

Routine NAI status reporting is accomplished throughout the management levels. This includes:

1. Monthly status report by the NAI Director to ARC Center Director and Ames Management Council (AMC).
2. Monthly progress report to NASA Headquarters Office of Space Science, Origins Theme Director. Representatives of the Offices of Earth Sciences and Life and Microgravity Sciences and Applications will be included and invited as part of the regular reporting process.

The NAI will schedule reports to match existing OSS review cycles and examine using server/website for reports similar to other OSS Codes.

As part of this management responsibility, Ames Research Center has developed some formalized procedures for planning, budgeting, tracking, and reporting. To enable Ames to successfully perform this effort and optimize the use of available funds, Institute members are required to submit quarterly financial reports, SF 272 (See Cooperative Agreement (CA) General Provision 1260.26, Financial Management) and an annual spending plan outlining by month the planned obligations and costings of their CA funds. The spending plan for the first year shall be submitted within 30 calendar days of the award date of the CA and for Years 2 through 5 within 30 days of the renewal date. Institute members will notify the NAI Director's office of any

significant deviations in spending/costing from the spending plan (a significant deviation is defined as change + or - 20% over a period of two months).

In addition to the annual technical report requirement by CA General Provision 1260.21, Publications and Reports, Institute members will regularly report research progress to the NAI Director through conference calls, e-mail, videoconferences or face-to-face meetings as appropriate.

### 5.2 Interim Organization

An interim management team has been appointed for the initial establishment of the NAI. Reporting for the interim period is the same as given in Figure 1 for the permanent organization. The interim manager of the Astrobiology Institute reports the status and performance of NAI to the Ames Center Director, and OSS Origins Theme Director. Duties of the Interim Manager are described in Section 6.2.

## 6. MANAGEMENT RESPONSIBILITIES

The management responsibilities described in this section are derived from and compliant with the NASA Strategic Management Handbook and the ARC Implementation Plan.

### 6.1 At NASA Headquarters

Associate Administrator: The Associate Administrator for Space Science , in concert with the Offices of Earth Sciences and Life and Microgravity Sciences and Applications, is responsible for formulating top-level program requirements and objectives, allocating resources for the full program cost, within the constraints of annual Congressional appropriations, approving implementation plans, reviewing and concurring with interagency agreements, assessing performance and compliance to requirements and expectations, providing science leadership, serving as the NASA "internal customer," providing direction on public affairs, and designating the program Lead Center–in this case, ARC. The Institute objectives, functional responsibility, budget, and metrics are formally established in this implementation plan signed by the Associate Administrator. The Astronomical Search for Origins Theme Director and his staff act as the principal agent of the Associate Administrator in the Office of Space Science for the development phase of the NAI, primarily in continuously assessing institute performance

### 6.2 At Ames Research Center

Per the OSS letter dated July 16, 1997, Ames Research Center has been designated the Lead Center for Astrobiology. One of the key responsibilities is the management of the NAI on behalf of OSS.

Center Director: The ARC Director has full management responsibility and authority and, thus, full accountability for the NAI. He will ensure that ISO 9001 processes, system level procedures, and standards are implemented and maintained.

Institute Director: The Director of the NAI will be selected by the ARC Director with Headquarters concurrence. The NAI Director will be supervised by the ARC Center Director. The responsibilities of the Institute are listed in section 3.3 above. The Director will be responsible for selecting a Deputy Director or Managing Director as needed for his/her staff.

Specific Responsibilities of Interim Manager: The OSS letter dated July 16, 1998, required ARC to appoint an Interim Manager. In a letter to the Institute Members dated July 17, 1998, the ARC Center Director made this appointment which continues until the permanent Institute Director is selected and in place at ARC. The general assignment of the Interim Manager is to establish the technical and managerial foundations of the NAI. Some of the more specific duties are as follows:

1. Prepare the Astrobiology Implementation Plan.
2. Recruit both interim and permanent institute staff to execute institute functions.
3. Assist the ARC Center Director in developing the process and schedule for the recruitment of a permanent Institute Director.
4. Assure timely completion of member Institution agreements.
5. Provide monthly progress reports to ARC senior management and NASA Headquarters.
6. Develop Institute Operating Plans.
7. Develop Institute networking and virtual collaboration plans.

Unless specifically agreed with OSS, Interim Manager's duties do not include science direction.

## 7. INSTITUTE RESOURCES

The NASA Astrobiology Institute program shall be conducted within annual Program Operating Plan (POP) guidelines. Member Institution agreement periods of performance are on July/June centers and will be incrementally funded. The table below shows the currently anticipated program resources associated with institute operations over a 5-year period commencing on July 1, 1998.

**NAI FUNDING PROFILE (FY R&D, $M)**

| | FY98 | FY99 | FY00 | FY01 | FY02 |
|---|---|---|---|---|---|
| Member Institution Agreements | 2.8 | 7.2 | 11.1 | 11.1 | 11.1 |
| Post Doc Program | | | 0.7 | 0.7 | 0.8 |
| Director's Discretionary Fund | | 0.3 | 0.3 | 0.3 | 0.3 |
| Network/Communications | | 0.4 | 0.8 | TBD | TBD |
| Education & Public Outreach | | 0.3 | 0.5 | 0.6 | 0.6 |
| Indirect Support | 0.7 | 0.8 | 1.2 | 1.2 | 1.2 |
| Expanded NAI Scope | | | 1.4 | 1.1 | 1.0 |
| **TOTAL** | **3.5** | **9.0** | **16.0** | **15.0** | **15.0** |

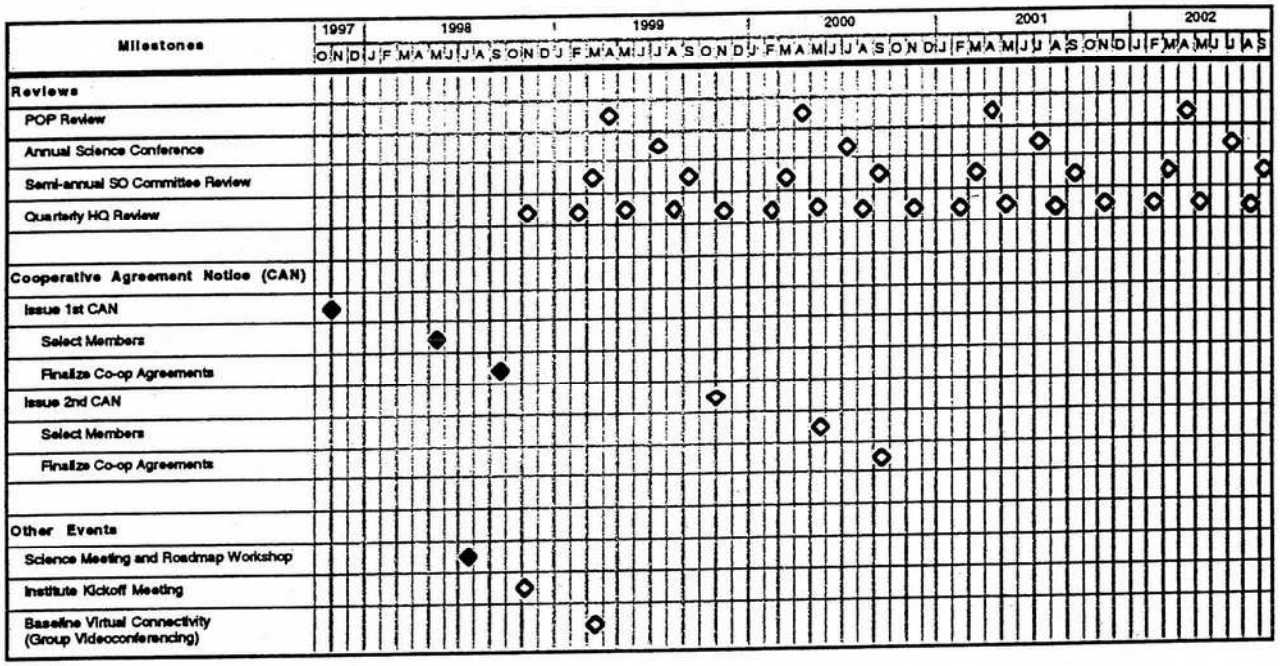
The NAI is jointly funded by the Offices of Space Science and Earth Science enterprises as follows:

| | FY98 | FY99 | FY00 | FY01 | FY02 |
|---|---|---|---|---|---|
| Office of Space Science | 2.5 | 8.0 | 15.0 | 15.0 | 15.0 |
| Office of Earth Science | 1.0 | 1.0 | 1.0 | TBD | TBD |

The Office of Life and Microgravity Science and Applications may provide additional contributions at a later date.

## 8. INSTITUTE TOP-LEVEL SCHEDULE

The top-level schedule for the institute is shown in Figure 2. Because the NAI is still in a "start-up" definition mode, the schedule is of necessity top-level and approximate. During the first Institute year, more detail will be provided.



# 9. CONTROLS AND METRICS

## 9.1 Controlled Items

The following items are controlled by NASA Headquarters and any changes to any of them shall be approved by the NASA Associate Administrator for Space Science:

- Institute objectives
- Institute budget and top-level allocations, as reviewed through the POP cycle

## 9.2 Metrics

Success metrics for the NAI listed in descending order of importance shall be the following:

1. Scientific and technical progress in accomplishing the goals of the multidisciplinary research program, including innovative and novel approaches as measured by peer-reviewed publications in professional journals and the assessment of the Independent Science Oversight Committee.
2. Level and quality of institutional commitment of the Institute members to the emerging field of Astrobiology, including training of students and postdoctoral fellows who will make up the next generation of Astrobiology researchers.
3. Efforts and approaches made to strengthen the ties among members of the Institute and increase its overall scientific productivity including, for example, ways to use modern information approaches that are intended to be implemented by proposing institutions as well as ideas for Institute-wide activities.
4. Education and public affairs programs.

# 10. EDUCATION AND PUBLIC OUTREACH (E&PO)

A major goal of NASA's program in Astrobiology is to capitalize on the great public appeal of Astrobiology by building an education and public affairs program to share the excitement of discovery with the public. Institute members are expected to be involved in education and public affairs programs and to work with the Institute Director's office to integrate their efforts in this area into the overall NAI program. Education and outreach to the public will remain an active topic of discussion during the NAI communications and meetings. Sharing of accomplishments and approaches with other NAI members will help avoid duplication of effort and will facilitate the generation of new ideas.

The following activities comprise the early stage planning for E&PO:

1. An Institute office Outreach Manager will be appointed to maintain cognizance and suggest synergies.
2. ARC Public Affairs Officer assigned to work media interface through HQ (Code P and OSS Public Affairs Office).
3. Review and coordination of Institute members' E&PO plans.
4. Development of leadership role for Institute Outreach through coordination efforts (above) and inception of innovation outreach activities in which member Institutes will participate.
5. Institute will create and distribute materials (Internet, print, video, electronic) identifying the Institute and the content area of Astrobiology.

6. Coordinate with OSS and with appropriate education forums (e.g. Origins, Solar Systems Exploration, etc.).

## 11. EXTERNAL REVIEW

External review will be provided by a Headquarters chartered independent oversight committee consisting of scientists from all the disciplines comprising Astrobiology. The Chair of this committee will be appointed jointly by the ARC Center Director and NASA Headquarters OSS and will include representation from the Offices of Earth Sciences and Life and Microgravity Sciences and Applications. The committee will review all aspects of the NAI. It will evaluate the progress, the top-level science policy and direction of NAI and judge whether the goals of the Institute are being met. The committee will meet at least annually and more frequently as need dictates. Reports will be provided to the Ames Center Director, Institute Director, and the NASA Headquarters Office of Space Science.

## 12. CHANGES AND MODIFICATIONS

This agreement will be in effect from the time of the final signature. As specified in ISO 9001, this document will constitute the contract between NASA ARC and Headquarters OSS for the work and products described herein. Changes and modifications may be proposed by any signatory, and review is anticipated at the time the permanent Director is selected.